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**DRAFT ELEMENT FOR SECTION 3.1.2.3 OF THE CONFERENCE PREPARATORY
MEETING REPORT TO WRC-2000**

3.1.2.3 Feasibility of the limits and constraints on the development of the systems and services involved

Employing hard limits without a coordination procedure is a common practice in the Radio Regulations in those instances where the cost of the constraints accepted by the services involved are outweighed by the benefit of coexistence without the need for coordination. Studies demonstrate that the provisional EPFD_{down} limits and associated percentages of time do not adequately protect existing GSO FSS networks with very large earth station antennas. EPFD_{down} limits and associated percentages of time that would provide sufficient protection to GSO networks having very large earth station antennas would be substantially more stringent than limits that would protect other sensitive links. Coordination would provide an alternative sharing arrangement without placing onerous constraints on the design of non-GSO systems. However, it is accepted that for coordination to be a satisfactory solution for the non-GSO system operators there should be very few cases requiring coordination. Therefore, the thresholds for triggering coordination must be set such that coordination is triggered in relatively few cases. WP 4A agreed that coordination would be triggered for GSO FSS networks having very large earth station antennas and meeting a combination of thresholds based on the GSO FSS earth station antenna gain and G/T and space station emission bandwidth. Regulatory and procedural conditions may also be needed to further reduce the number of cases requiring coordination.

The results of studies reported in Sections 3.1.2.1 and 3.1.2.2 of this CPM Report are intended to enable conclusions to be reached as to the appropriate power limits to be placed on non-GSO FSS systems, and in some cases on GSO FSS systems. From these conclusions, WRC-2000 will be in a position to adopt appropriate power limits adopted for certain bands, and in so doing, will attempt to ensure that the power limits provide the desired protection to GSO FSS and GSO BSS networks without causing undue constraints to any of the systems and services sharing these frequency bands.

In order to ensure that GSO networks are provided the intended degree of protection by the power limits, WRC-2000 should consider providing a means by which the power limits can be adjusted, as necessary, or other remedial measures can be taken, in particular cases as experience with the new regime is gained.



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**DRAFT ELEMENT FOR SECTION 3.1.2.4 OF THE CONFERENCE PREPARATORY
MEETING REPORT TO WRC-2000**

Introduction

JTG 4-9-11 urged administrations to develop text defining the possible options for addressing the technical conclusions of the JTG as CPM input on regulatory and procedural matters for the final JTG meeting (Report of the third meeting of JTG 4-9-11, Long Beach, United States, January 1999, Section 6.1). JTG 4-9-11 sought additional technical input from WP 4A, which sent several liaison statements to JTG 4-9-11 documenting the technical agreements reached during its 26 April - 4 May, 1999 meeting for use as bases for the development of CPM text. Regulatory and procedural considerations for addressing the technical conclusions of JTG 4-9-11, with input from WP 4A, are summarized below.

3.1.2.4 Regulatory and procedural considerations

3.1.2.4.1 Definition of the $EPFD_{down}$, $EPFD_{up}$ and $EPFD_{is}$

In order to address the interference into the GSO FSS receive space stations caused by non-GSO FSS space stations operating in opposite direction of transmission, it was agreed to introduce the additional concept of $EPFD_{is}$ (for inter-satellite) and to include in Article S22 $EPFD_{is}$ limits identical to the limits applicable to protect the same GSO FSS receive space stations from interference by NGSO FSS uplinks ($EPFD_{up}$). To simplify the Radio Regulations and facilitate the understanding of the provision of Article S22, it was also agreed that the same, generic mathematical definition, should be used for the $EPFD_{down}$, the $EPFD_{up}$ and the $EPFD_{is}$. Annex 1 contains regulatory text that is considered to reflect the agreed changes.

3.1.2.4.2 $EPFD_{up}$ and $EPFD_{is}$ limits

The results of the studies concerning $EPFD_{up}$ and $EPFD_{is}$ and the associated change in definition have lead to agreement that the $EPFD_{up}$ and $EPFD_{is}$ limits should be those in Table S22-2 and Table S22-3 given in Annex 2. These would replace Table S22-2 (WRC-97) and Table S22-4 (WRC-97).

3.1.2.4.3 $EPFD_{down}$ limits

It has been agreed that curves of $EPFD_{down}$ as a function of time, i.e. masks, should be used for the $EPFD_{down}$ rather than discrete points as adopted by WRC-97. The ITU-R decided to develop $EPFD_{down}$ masks for the following earth-station antenna sizes and frequency bands:

- 0.6 m, 1.2 m, 3, and 10 m in a 40 kHz reference bandwidth in the frequency band 10.7 - 12.75 GHz;
- 70 cm, 90 cm and 2.5 m in the frequency band 19.7 - 20.2 GHz in reference bandwidths of 1 MHz and 40 kHz.

No conclusions were reached in the frequency band 17.8 - 18.6 GHz based on consideration of a range of EPFD_{down} masks for GSO antenna sizes smaller than 1 m up to 5 m (the provisional limits include antenna sizes up to 12 m). The ITU-R agreed that the EPFD_{down} mask for the 60 cm and 1.2 m antenna size in the frequency band 10.7 - 12.75 GHz shown in Section 3.1.2.1.4.2 would adequately protect GSO earth stations. All other EPFD_{down} masks in the 10.7 - 12.75 GHz, 17.8 - 18.6 GHz, and 19.7 - 20.2 GHz frequency bands have been bounded by the ranges shown in Section 3.1.2.1.4.2. Regulatory provisions are needed to incorporate the EPFD_{down} masks adopted for the range of GSO FSS antenna sizes in each frequency band into Article S22. These masks would replace Table S22-3 (WRC-97).

3.1.2.4.4 Operational EPFD

Operational EPFD levels form a measure of protection for GSO FSS networks from loss of synchronization. The ITU-R has determined that the following understandings form the framework for a potential sharing arrangement between non-GSO FSS and GSO FSS systems in frequency bands where provisional power limits were established in Resolution 130 (WRC-97):

- a) the Radiocommunication Bureau, under S9.35 and S11.31, would verify the compliance of each non-GSO FSS system with the Article S22 EPFD masks in the appropriate frequency bands. Any non-GSO FSS system that is found non-compliant under the validation software would not receive a favourable finding from the BR;
- b) in addition to the "Validation EPFD levels", "Operational EPFD levels" would be recognized in the Radio Regulations. These are the actual levels produced by a non-GSO FSS system and will be lower than the EPFD levels that are examined by the BR using the validation software ("Validation EPFD levels") due to the use of several worst-case assumptions that overestimate the EPFD produced by a non-GSO system. Non-GSO FSS systems will be deemed to have met the 0% of time requirement under S.22.2 if their EPFD never exceeds the operational levels into any operating GSO/FSS earth station having gain exceeding 59 dBi in the band 10.7 - 12.75 GHz or 5 m diameter in the band 17.8 - 18.6 GHz and 3.5 m to 5 m in the band 19.7 - 20.2 GHz¹;
- c) if an operating non-GSO FSS system exceeds the "Operational EPFD levels", it would be required to take all necessary steps to ensure, as expeditiously as possible, that interference caused to GSO systems is restored to levels at or below the "Operational EPFD levels";
- d) the determination of whether a non-GSO FSS system is exceeding the "Operational EPFD levels" would be made by individual administrations and their GSO systems operators. A regulatory approach similar to that indicated in Article S15 could be used to implement this provision.

It will be necessary to develop regulatory provisions (e.g., modifications to Article S22, Appendix S4, and Articles S9 and S11) to implement the Operational EPFD framework. A resolution would be an appropriate vehicle for bringing such measures into effect immediately after the conclusion of WRC-2000.

¹ For the band 19.7 - 20.2 GHz, the operational EPFD level of -143 dBW/m²/MHz (-157 dBW/m²/40 kHz) had some support in the ITU-R.

The "Operational EPFD level" approach described in Section 3.1.2.4.4 does not apply to very large antennas as discussed in Section 3.1.2.4.7.

3.1.2.4.5 Off-axis e.i.r.p.

WRC-97 adopted off-axis e.i.r.p. limits in the bands 12.75 - 13.25 GHz, 13.75 - 14 GHz, 14 - 14.5 GHz bands; these limits were suspended pending review by WRC-99. It was agreed that any off-axis e.i.r.p. density masks for GSO networks would be used as guidance by non-GSO systems designers in assessing the maximum interference level a non-GSO would receive from future GSO networks (Document 4-9-11/375). It was also agreed that these masks would not apply to GSO earth station antennas put into operation at any time and operating with a satellite network in the fixed-satellite service for which complete coordination or notification information has been received before 2 June 2000. No off-axis e.i.r.p. limits applicable to non-GSO FSS earth stations should be included in the Radio Regulations. Telecommand and ranging carriers transmitted to geostationary satellites in the fixed-satellite service would be able to exceed the off-axis e.i.r.p. levels in the normal mode of operation and would be exempt in case of *force majeure*. Regulatory provisions will be needed to address the date of coming into effect as well as changes to Section VI of Article S22. Example changes to the Section VI of Article S22 to reflect results of studies are indicated in Annex 3.

3.1.2.4.6 Update of the regulatory provisions for frequency bands covered by Resolution 130 (WRC-97)

It is expected that WRC-2000 will confirm or revise the power limits appearing in Article S22 and Resolution 130 (WRC-97) and that most of the regulatory and procedural provisions contained in Resolution 130 (WRC-97) would no longer be required. The decisions of WRC-2000 are likely to come into effect at some future date, generally a year or more after the conference. A new Resolution may be needed to address timing issues and provisions that are not carried into Article S22 (e.g., bringing the adopted power limits into effect according to the timetable established in Resolution 130, examination of non-GSO FSS systems already received by the Bureau for compliance with the EPFD limits, etc.).

3.1.2.4.7 Very large earth station antennas

Regulatory and procedural work is needed to establish coordination between non-GSO FSS transmitting space stations and GSO receive earth stations with very large antennas. ITU-R has selected 64 dBi in the band 10.7 - 12.75 GHz and 68 dBi in the bands 17.8 - 18.6 GHz and 19.7 - 20.2 GHz as the GSO earth station receive antenna gain above which hard limits may be replaced by a coordination procedure. These gain thresholds correspond to an antenna diameter of approximately 16 m, with most antennas being 18 m or larger. Under the current regulatory regime, there is no regulatory need to request coordination for a "specific" earth station unless it is operating in a shared band with terrestrial networks or in the opposite direction of transmission of other earth stations and the coordination area of the specific earth station includes the territory of another country. Both non-GSO FSS systems requesting coordination with specific earth stations associated with GSO FSS networks and specific earth stations associated with GSO FSS networks requesting coordination with non-GSO FSS systems need to be covered. Implementation of this coordination procedure may include additions or modifications to Articles S5, S9 and S22, and Appendixes S4 and S5. Annex 4 contains regulatory and procedural text for coordination between non-GSO FSS transmitting space stations and GSO receive earth stations with very large antennas. Additional regulatory and procedural conditions (e.g., due diligence provisions) might be needed to reduce the number of cases requiring coordination.

3.1.2.4.8 Inclined geostationary orbits

ITU-R agreed that the EPFD_{down} masks adopted for the protection of non-inclined GSO links would also protect links using satellites in slightly inclined orbits up to 2.5° inclination. However, where an operator can demonstrate that the actual inclination of his in service GSO satellite has exceeded 2.5°, it was agreed that he should have recourse to a regulatory procedure to resolve any problems of interference exceeding the relevant EPFD_{down} mask. Regulatory work is needed to develop such a procedure.

3.1.2.4.9 Software

Software will be used by the BR to compute EPFD statistics from a constellation of non-GSO satellites at specific GSO earth station locations. The cumulative probability distribution function (CDF) curves of EPFD for a single non-GSO system produced by the software would then be tested against the EPFD limits in the Radio Regulations for a decision as to whether the non-GSO system satisfied or failed the EPFD limits. It is envisioned that any non-GSO system that did not meet the EPFD limits and associated time percentages would receive an unfavorable finding from the Bureau. Regulatory and procedural work is needed regarding the examination process and results, including the following:

- a) procedure for using the software;
- b) required input information, including any modification of Appendix S4 data to be supplied by the administration for the non-GSO system and BR examination of input data for correctness and completeness before the data is used as software input;
- c) GSO earth station location test points supplied by administrations in order to help resolve cases of dispute or to evaluate locations other than those where maximum EPFD levels occur;
- d) time-frames, including the order in which non-GSO systems will be examined and establishing the time between submittal of data and completion of the examination
- e) publication requirements for input and output data;
- f) outputs from the software, including basic outputs available to all administrations and detailed outputs that the BR could make available to the administration submitting the application, for their internal use and for use in case of a dispute;
- g) procedures to allow the BR and administration concerned to inspect the detailed output and resubmit incomplete or incorrect input information in cases where unfavorable findings are received. Procedural work will be necessary to distinguish between "incorrect or incomplete information" and other changes in the system.

ANNEX 1

Definition of the EPFD_{down}, EPFD_{up} and EPFD_{is}

Annex 1 contains regulatory text that is considered to reflect the agreed changes to use the same, generic mathematical definition for the EPFD_{down}, the EPFD_{up} and the EPFD_{is}.

MOD S22.5B § 5 1) The equivalent power flux-density², EPFD_{down}, at any point on the Earth's surface visible from the geostationary-satellite orbit, produced by emissions from all the space stations of a non-geostationary-satellite system in the fixed-satellite service in the frequency bands listed in Table S22-1, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limits given in Table S22-1 for the given percentages of time. These limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions, into a reference antenna and in the reference bandwidth specified in Table S22-1, for all pointing directions towards the geostationary-satellite orbit.

MOD S22.5B.1 The equivalent power flux-density is defined as the sum of the power flux-densities produced at a GSO receive station on the Earth's surface or in the geostationary orbit, as appropriate, by all the transmit stations within a non-geostationary-satellite system, taking into account the off-axis discrimination of a reference receiving antenna assumed to be pointing its nominal direction. The equivalent power flux-density is calculated using the following formula:

$$epfd = 10 \cdot \log_{10} \left[\sum_{i=1}^{N_a} 10^{\frac{P_i}{10}} \cdot \frac{G_i(\theta_i)}{4\pi d_i^2} \cdot \frac{G_r(\phi_r)}{G_{L,max}} \right]$$

where:

- N_a is the number of transmit stations in the non-geostationary-satellite system that are visible from the GSO receive station considered on the Earth's surface or in the geostationary orbit, as appropriate
- i is the index of the transmit station considered in the non-geostationary-satellite system
- P_i is the RF power at the input of the antenna of the transmit station, considered in the non-geostationary satellite system in dBW in the reference bandwidth
- θ_i is the off-axis angle between the boresight of the transmit station considered in the non-geostationary satellite system and the direction of the GSO receive station
- $G_i(\theta_i)$ is the transmit antenna gain (as a ratio) of the station considered in the non-geostationary satellite system in the direction of the GSO receive station
- d_i is the distance in metres between the transmit station considered in the non-geostationary satellite system and the GSO receive station

ϕ_i	is the off-axis angle between the boresight of the antenna of the GSO receive station and the direction of the i th transmit station considered in the non-geostationary satellite system
$G_r(\phi_i)$	is the receive antenna gain (as a ratio) of the GSO receive station in the direction of the i th transmit station considered in the non-geostationary satellite system
$G_{r,max}$	is the maximum gain (as a ratio) of the antenna of the GSO receive station
$epfd$	is the computed equivalent power flux-density in dB(W/m ²) in the reference bandwidth

MOD S22.5C

2) The equivalent power flux-density², EPFD_{up}, produced at any point in the geostationary-satellite orbit by emissions from all the earth stations in a non-geostationary-satellite system in the fixed-satellite service in the frequency bands listed in Table S22-2, for all conditions and for all methods of modulation, shall not exceed the limits given in Table S22-2 for the specified percentages of time. These limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions, into a reference antenna and in the reference bandwidth specified in Table S22-2, for all pointing directions towards the Earth's surface visible from the geostationary-satellite orbit.

MOD S22.5D

3) The equivalent power flux-density², EPFD_{is}, produced at any point in the geostationary-satellite orbit by emissions from all the space stations in a non-geostationary-satellite system in the fixed-satellite service in the frequency bands listed in Table S22-3, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limits given in Table S22-3 for the specified percentages of time. These limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions into a reference antenna and in the reference bandwidth specified in Table S22-3, for all pointing directions towards the Earth's surface visible from the geostationary-satellite orbit.

ANNEX 2

EPFD_{up} and EPFD_{is} limits

TABLE S22-2

Limits to the EPFD_{up} radiated by non-GSO FSS systems in certain frequency bands

Frequency band (GHz)	EPFD _{up} dB(W/m ²)	Percentage of time during which epfd level may not be exceeded	Reference bandwidth (kHz)	Reference GSO space station antenna beamwidth and reference radiation pattern
12.5 - 12.75 12.75 - 13.25 13.75 - 14.5	-160	100	40	4 degrees, ITU-R S.672, L _s = -20
17.3 - 18.1 in Regions 1 and 3 17.8 - 18.1 in Region 2	[-153]	100	40	[4 degrees, ITU-R S.672, L _s = -20]
27.5 - 28.6	-148	100	1 000	1.55 degrees, ITU-R S.672, L _s = -10**
29.5 - 30.0	-148	100	1 000	1.55 degrees, ITU-R S.672, L _s = -10**

TABLE S22-3

Limits to the EPFD_{is} radiated by non-GSO FSS systems in certain frequency bands

Frequency band (GHz)	EPFD _{inter-satellite} dB(W/m ²)	Percentage of time during which epfd level may not be exceeded	Reference bandwidth (kHz)	Reference GSO space station antenna beamwidth and reference radiation pattern
10.7 - 11.7 in Region 1 12.5 - 12.75 in Region 1 12.7 - 12.75 in Region 2	-160	100	40	4 deg., ITU-R S.672, L _s = -20
17.8 - 18.4 GHz	[-153]	100	[40]	[4 deg., ITU-R S.672, L _s = -20]

** In the equations in Recommendation ITU-R S.672, the same values of the a and b parameters as used with L_s = - 20 should be used.

ANNEX 3

Off-axis e.i.r.p.

SECTION VI

EARTH STATION OFF-AXIS POWER E.I.R.P. LIMITATIONS IN ON EARTH STATIONS IN GSO NETWORK OPERATING IN THE FIXED-SATELLITE SERVICE

MOD S22.26 The level of equivalent isotropically radiated power (e.i.r.p.) emitted by an earth station operating to an geostationary orbit satellite shall not exceed the following values for any off-axis angle, ϕ , which is 2.5° or more off the main-lobe axis of an earth station antenna in any direction outside of 3° of the GSO arc:

Off-axis angle	Maximum e.i.r.p.
$2.53^\circ \leq \phi \leq 7^\circ$	3942 -25 log ϕ dB(W/40 kHz)
$7^\circ < \phi \leq 9.2^\circ$	1821 dB(W/40 kHz)
$9.2^\circ < \phi \leq 48^\circ$	4245 -25 log ϕ dB(W/40 kHz)
$48^\circ < \phi \leq 180^\circ$	03 dB(W/40 kHz)

MOD S22.27 For FM-TV emissions with energy dispersal, the limits in No. S22.26 above may be exceeded by up to 3 dB provided that the off-axis total e.i.r.p. of the transmitted FM-TV carrier does not exceed the following values:

Off-axis angle	Maximum e.i.r.p.
$2.53^\circ \leq \phi \leq 7^\circ$	5356 -25 log ϕ dBW
$7^\circ < \phi \leq 9.2^\circ$	3235 dBW
$9.2^\circ < \phi \leq 48^\circ$	5659 -25 log ϕ dBW
$48^\circ < \phi \leq 180^\circ$	1417 dBW

MOD S22.28 FM-TV carriers which operate without energy dispersal should be modulated at all times with programme material or appropriate test patterns. In this case, the off-axis total e.i.r.p. of the emitted FM-TV carrier shall not exceed the following values:

Off-axis angle	Maximum e.i.r.p.
$2.53^\circ \leq \phi \leq 7^\circ$	5356 -25 log ϕ dBW
$7^\circ < \phi \leq 9.2^\circ$	3235 dBW
$9.2^\circ < \phi \leq 48^\circ$	5659 -25 log ϕ dBW
$48^\circ < \phi \leq 180^\circ$	1417 dBW

NOC S22.29 The e.i.r.p. limits given in Nos. **S22.26**, **S22.27** and **S22.28** are applicable to earth terminals operating to geostationary satellites in the following frequency bands allocated to the fixed-satellite service (Earth-to-space):

12.75 - 13.25 GHz

13.75 - 14 GHz

14 - 14.5 GHz.

ADD S22.30 The level of equivalent isotropically radiated power (e.i.r.p.) emitted by an earth station operating to a geostationary satellite in the 29.5 - 30 GHz frequency band shall not exceed the following values for any off-axis angle, ϕ , in any direction outside 3° of the geostationary arc:

Angle off-axis	Maximum e.i.r.p. per 40 kHz
$3^\circ \leq \phi \leq 7^\circ$	22-25 log ϕ dBW
$7^\circ < \phi \leq 9.2^\circ$	1 dBW
$9.2^\circ < \phi \leq 48^\circ$	25-25 log ϕ dBW
$48^\circ < \phi \leq 180^\circ$	-7 dBW

ADD S22.31 The e.i.r.p. limits given in Nos. **S22.26**, **S22.27**, **S22.28** and **S22.30** do not apply to earth station antennas operating to a geostationary satellite and ready to be in service² prior to [XXXX] nor to earth station associated with a geostationary satellite network in the fixed satellite service for which complete coordination or notification information has been received before 2 June 2000.

ADD S22.32 Telecommand and ranging carriers transmitted to geostationary satellites in the fixed-satellite service in normal mode of operation (i.e. earth station transmitting telecommand and ranging carriers to a directive receiving antenna on the geostationary space station) may exceed the levels given in **S22.26** by no more than 16 dB in the frequency bands 12.75 - 13.25 and 13.75 - 14.5 GHz and may exceed the levels given in **S22.30** by no more than [Y] dB in the frequency band 29.5 - 30 GHz.

In all other modes of operation, and in case of *force majeure*, telecommand and ranging carriers transmitted to geostationary satellites in the fixed-satellite service are exempted from the levels given in **S22.26** and **S22.30**.

ADD S22.33 The level of e.i.r.p. should determined in such a manner that 90% of the peak off-axis e.i.r.p. density values, in the off-axis angular range beyond 10° , do not exceed the values given in Nos. **S22.30**.

ADD S22.34 During rain faded conditions, the levels in Nos. **S22.30** may be exceeded by earth terminals implementing power control and should be returned to the nominal value as soon as the attenuating weather pattern subsides.

² "Ready to be in service" relates to the case where antennas have been installed but the start of service has been delayed due to force majeure.

ANNEX 4

Regulatory and procedural text for coordination between non-GSO FSS transmitting space stations and GSO receive earth stations with very large antennas

This annex contains example regulatory and procedural text for coordination between non-GSO FSS transmitting space stations and GSO receive earth stations with very large antennas, including additions and/or modifications to Articles S5, S9, S22 and Appendices S4 and S5.

MOD S5.441 The use of the bands 4 500 - 4 800 MHz (space-to-Earth), 6 725 - 7 025 MHz (Earth-to-space) by the fixed-satellite service shall be in accordance with the provisions of Appendix S30B. The use of the bands 10.7 - 10.95 GHz (space-to-Earth), 11.2 - 11.45 GHz (space-to-Earth) and 12.75 - 13.25 GHz (Earth-to-space) by geostationary-satellite systems in the fixed-satellite service shall be in accordance with the provisions of Appendix S30B. The use of the bands 10.7 - 10.95 GHz (space-to-Earth), 11.2 - 11.45 GHz (space-to-Earth), and 12.75 - 13.25 GHz (Earth-to-space) by non-geostationary-satellite systems in the fixed-satellite service shall be in accordance with the provisions of Resolution 130 (WRC-97) Article S22 and No. S9.12. The use of the bands 10.7 - 10.95 GHz (space-to-Earth) and 11.2-11.45 GHz (space-to-Earth) is subject to the provisions of No. S9.16A and S9.16B.

MOD S5.484A The use of the bands 10.95 - 11.2 GHz (space-to-Earth), 11.45 - 11.7 GHz (space-to-Earth), 11.7 - 12.2 GHz (space-to-Earth) in Region 2, 12.2 - 12.75 GHz (space-to-Earth) in Region 3, 12.5 - 12.75 GHz (space-to-Earth) in Region 1, 13.75 - 14.5 GHz (Earth-to-space), 17.8 - 18.6 GHz (space-to-Earth), 19.7 - 20.2 GHz (space-to-Earth), 27.5 - 28.6 GHz (Earth-to-space), 29.5 - 30 GHz (Earth-to-space) by non-geostationary- and geostationary-satellite systems in the fixed-satellite service is subject to the provisions of Resolution 130 (WRC-97) Article S22 and No. S9.12. The use of the bands 10.95 - 11.2 GHz (space-to-Earth), 11.45 - 11.7 GHz (space-to-Earth), 11.7 - 12.2 GHz (space-to-Earth) in Region 2, 12.2 - 12.75 GHz (space-to-Earth) in Region 3, 12.5 - 12.75 GHz (space-to-Earth) in Region 1, 17.8 - 18.6 GHz (space-to-Earth), and 19.7 - 20.2 GHz (space-to-Earth) is subject to the provisions of No. S9.16A and S9.16B. The use of the band 17.8-18.1 GHz (space to Earth) by non-geostationary fixed-satellite service systems is also subject to the provisions of Resolution 538 (WRC-97).

Reasons: The references to Resolutions 130 (WRC-97) and 538 (WRC-97) were replaced by a reference to Article S22 where the non-transitional provisions of these resolutions are contained. The Article S9 provisions for stations for which the requirement to coordinate is included in a footnote to the Table of Frequency Allocations were specified in order to clarify the requirements for coordination under the existing No. S9.12. The proposed S9.16A and S9.16B would require coordination between non-GSO FSS transmit satellites and GSO FSS receive earth stations with large antennas. GSO FSS earth stations with large antennas are not adequately protected by the EPFD_{down} levels contained in Table S22-3 and case-by-case coordination of systems operating co-frequency, co-directional links in the space-to-Earth direction is required. By referring to coordination provisions under S9.16A and

- X Mandatory information
- O Optional information
- C This information need only be furnished when it has been used as a basis to effect coordination with another administration

zz Specific associated earth station information required for coordination under No. S9.16A or S9.16B.

Reasons: This is consequential to proposed modifications to footnotes S5.441 and S5.484A. Administrations will need to submit specific earth station information for earth stations associated with geostationary-satellite networks in the fixed-satellite service with maximum antenna gains as specified in the proposed addition to Appendix S5.

ADD

APPENDIX S5
TABLE S5-1 (CONTINUED)

Reference of Article S9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. S9.16A GSO earth station/ NGSO system	A specific earth station in a geostationary satellite network in the fixed-satellite service in respect of a non-geostationary-satellite system in the fixed-satellite service.	The following frequency bands subject to S5.441 or S5.484A: 10.7 - 11.7 GHz (space-to-Earth), 11.7 - 12.2 GHz (space-to-Earth) in Region 2, 12.2 - 12.75 GHz (space-to-Earth) in Region 3, 12.5 - 12.75 GHz (space-to-Earth) in Region 1, 17.8 - 18.6 GHz (space-to-Earth), and 19.7 - 20.2 GHz (space-to-Earth)	Conditions: i) the frequency bands overlap and ii) the satellite network using the geostationary-satellite orbit has specific receive earth stations and meets all of the following conditions: a) earth station antenna maximum isotropic gain greater than or equal to 64 dBi for the frequency bands 10.7-12.75 GHz or 68 dBi for the frequency bands 17.8 - 18.6 GHz and 19.7 - 20.2 GHz b) G/T of 44 or higher c) space station emission bandwidth of 250 MHz or higher for the frequency bands 10.7 - 12.75 GHz or 800 MHz or higher for the frequency bands 17.8 - 18.6 GHz and 19.7 - 20.2 GHz.	i) compare frequency bands; and ii) use the maximum antenna gain of the specific receive earth station (Appendix S4 C.10.c.2), the lowest equivalent satellite link noise temperature (Appendix S4 C.10.5), and the space station emission bandwidth (Appendix S4 C.7.a) in the geostationary-satellite network as given in Appendix S4 data.	The thresholds/conditions for coordination do not apply to typical receive earth stations operating in satellite networks using the geostationary-satellite orbit.

No. S9.16B NGSO system/ GSO earth station/	A non-geostationary-satellite system in the fixed-satellite service in respect of a specific earth station in a geostationary satellite network in the fixed satellite service.	The following frequency bands subject to S5.441 or S5.484A : 10.7 - 11.7 GHz (space-to-Earth), 11.7 - 12.2 GHz (space-to-Earth) in Region 2, 12.2 - 12.75 GHz (space-to-Earth) in Region 3, 12.5 - 12.75 GHz (space-to-Earth) in Region 1, 17.8 - 18.6 GHz (space-to-Earth), and 19.7 - 20.2 GHz (space-to-Earth)	Conditions: i) the frequency bands overlap and ii) the satellite network using the geostationary-satellite orbit has specific receive earth stations and meets all of the following conditions: a) earth station antenna maximum isotropic gain greater than or equal to 64 dBi for the frequency bands 10.7 - 12.75 GHz or 68 dBi for the frequency bands 17.8 - 18.6 GHz and 19.7 - 20.2 GHz b) G/T of 44 or higher c) space station emission bandwidth of 250 MHz or higher for the frequency bands 10.7 - 12.75 GHz or 800 MHz or higher for the frequency bands 17.8 - 18.6 GHz and 19.7 - 20.2 GHz.	i) compare frequency bands; and ii) use the maximum antenna gain of the specific receive earth station (Appendix S4 C.10.c.2), the lowest equivalent satellite link noise temperature (Appendix S4 C.10.c.5), and the space station emission bandwidth (Appendix S4 C.7.a) in the geostationary-satellite network as given in Appendix S4 data.	The threshold/condition for coordination do not apply to typical receive earth stations operating in satellite networks using the geostationary-satellite orbit.
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Reasons: This is consequential to proposed changes to footnotes **S5.441** and **S5.484A**. Earth stations with large antenna gains as defined in the condition/threshold column are not adequately protected by the EPFD_{down} levels contained in Table **S22-3** and case-by-case coordination is required.

For FM-TV carriers, which operate without energy dispersal, should be modulated at all times with programme material or appropriate test patterns. In this case, the total off-axis e.i.r.p. of the emitted FM-TV carrier shall not exceed the following values:

Off-axis angle	Maximum e.i.r.p.
$3^\circ \leq \varphi \leq 7^\circ$	$56-25 \log \varphi$ dBW
$7^\circ < \varphi \leq 9.2^\circ$	35 dBW
$9.2^\circ < \varphi \leq 48^\circ$	$59-25 \log \varphi$ dBW
$48^\circ < \varphi \leq 180^\circ$	17 dBW

It was also agreed that these masks would not apply to earth station antennas put into operation at any time and operating with a satellite network in the fixed-satellite service for which complete coordination or notification material has been received before 2 June 2000.

b) 29.5 - 30 GHz band

Currently Section VI to Article S22 does not include any specification for the off-axis e.i.r.p. density limits for GSO FSS earth stations operating in the frequency bands 29.5 - 30.0 GHz. The principle of having such specifications included in the Radio Regulations, to give guidance in assessing the maximum interference level non-GSO systems would receive from the earth stations operating with GSO satellites, was agreed to by the JTG (JTG 4-9-11/367) and WP 4A (4A/TEMP/152).

The results of studies lead to the adoption of a modification to Recommendation ITU-R 524 found in Document 4A/TEMP/155 which are reflected in the following:

Grandfathering of existing earth stations

The off-axis e.i.r.p. density values given below do not apply to earth stations operating to networks put into operation before 2 June 2000.

Frequency range

The JTG and WP 4A agreed that the specification of an off-axis e.i.r.p. density limit for earth stations transmitting in the frequency range 27.5 - 30.0 GHz is needed because it would be preferable for the non-GSO networks designers to know the expected level of interference they may receive. However, it was noted that in view of the studies performed within the ITU-R and in the differences in the sharing environment between the various frequency sub-bands, the mask proposed below, would be only applicable for earth stations operating in the frequency range 29.5 - 30.0 GHz.

Off-axis e.i.r.p. density mask

Earth stations operating in networks in the GSO FSS operating in the 29.5 - 30 GHz frequency band are to be designed in such a manner that for any angle, φ , in any direction outside 3° of the GSO arc, the e.i.r.p. density should not exceed the following:

Off-axis angle	Maximum e.i.r.p.
$3^\circ \leq \varphi \leq 7^\circ$	$22-25 \log \varphi$ dB(W/40 kHz)
$7^\circ < \varphi \leq 9.2^\circ$	1 dB(W/40 kHz)
$9.2^\circ < \varphi \leq 48^\circ$	$25-25 \log \varphi$ dB(W/40 kHz)
$48^\circ < \varphi \leq 180^\circ$	-7 dB(W/40 kHz)

During rain faded conditions, the levels above may be exceeded by earth terminals when implementing uplink power control and should be returned to the nominal value as soon as the attenuating weather pattern subsides. The amount that the levels above may be exceeded is under study.

Earth stations operating in the 29.5 - 30 GHz band should be designed in such a manner that 90% of their peak off-axis e.i.r.p. density values do not exceed the values given above. The statistical processing of the off-axis e.i.r.p. density peaks should be dealt with using the method given in Recommendation ITU-R S.732.

3.1.2.2.4.2 Limits applicable to FSS earth stations operating with non-GSO satellites

To date there has been no technical studies on the need for establishing off-axis e.i.r.p. limits applicable to non-GSO FSS earth stations. There was agreement that the only possible reason for establishing such limits would be to facilitate sharing between non-GSO FSS systems. In addition, all technical studies conducted by the ITU-R apply only to GSO FSS earth stations, as clearly indicated by the scope of Recommendation ITU-R S.524, which summarizes the work performed to date by the ITU-R on this topic.

Sharing in the non-GSO environment depends on a wide variety of factors (e.g. orbits and number of satellites in each constellation, hand-over strategies, in-line avoidance techniques, and traffic patterns). Therefore, it is questionable whether any potential benefit of establishing limits would justify constraining, possibly unnecessarily, non-GSO FSS systems. Moreover, in some cases having off-axis limits would in fact make sharing between NGSO FSS systems more difficult, because it would prevent the introduction of link balancing, which has been recognized as an efficient mitigation technique to promote sharing (see Recommendation ITU-R [4A/TEMP/123]).

As a result, the ITU-R is of the view that no off-axis e.i.r.p. limits applicable to non-GSO FSS earth stations should be included in the Radio Regulations at this time.



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**DRAFT CPM CONTRIBUTION FOR SECTIONS 3.1.2.2 AND 3.1.3.2 CONCERNING
PROTECTION OF NON-GSO FSS SYSTEMS IN THE BANDS 12.75 - 13.25 GHz,
13.75 - 14.5 GHz, 17.3 - 18.1 GHz (REGIONS 1 AND 3), 17.8 - 18.1 GHz
(REGION 2) AND 29.5 - 30 GHz**

Due to the commonality between Sections 3.1.2.2 and 3.1.3.2 regarding protection of non-GSO FSS systems in the bands 12.75 - 13.25 GHz, 13.75 - 14.5 GHz, 17.3 - 18.1 GHz (Regions 1 and 3), 17.8 - 18.1 GHz (Region 2) and 29.5 - 30 GHz, common text is proposed to cover both sections.

**3.1.2.2 Protection of non-GSO FSS systems in the bands 12.75 - 13.25 GHz,
13.75 - 14.5 GHz, 17.3 - 18.1 GHz (Regions 1 and 3), 17.8 - 18.1 GHz (Region 2) and
29.5 - 30 GHz bands**

3.1.2.2.1 Characteristics of the non-GSO FSS

Joint Task Group 4-9-11 has been assigned the responsibility for reporting the results of studies called for by Resolutions 130 and 538 (WRC-97) to CPM-99. In response, technical characteristics for a number of proposed non-GSO FSS systems have been received and compiled in Recommendation ITU-R S.1328. Administrations may use the parameters to perform an initial assessment of the impact of interference from a GSO system into existing and planned non-GSO FSS.

3.1.2.2.2 Protection criteria

The criteria of Recommendation ITU-R S.1323 apply to the protection of non-GSO systems from interference caused by other FSS systems operating in the same band. The criteria for a non-GSO/FSS network is such that the internetwork interference caused by the earth and space station emissions of all other satellite networks operating in the same frequency band and that can potentially cause interference of a time-varying nature, should satisfy *recommends* 3.

The criterion in ITU-R S.1323 was not applied to studies of the bands 17.3 - 18.1 GHz (Regions 1 and 3). These frequencies are used in accordance with the Appendix 30A Plans which specify link parameters, e.g. e.i.r.p., coverage, antenna patterns, for the GSO BSS feeder links. Any assignment in the Plans or subsequent modifications entered in the Plan may operate under the parameters specified in the Plans.

3.1.2.2.3 Methodologies used to assess the adequacy of the limits to protect non-GSO FSS

For the protection of non-GSO systems, the link to be evaluated for adequacy is between a given non-GSO earth station and a selected satellite in the NGSO constellation. In such links the elevation angle, the slant range and the rain attenuation distribution all vary with time. In order to evaluate this dynamic nature, a convolution methodology has been developed, and can be used to assess the impact of GSO/FSS interference on non-GSO/FSS satellite systems, with respect to the protection criteria in ITU-R S.1323.

3.1.2.2.4 Results of studies relating to the review/revision of the provisional power limits appearing in Section VI of Article S22

3.1.2.2.4.1 Limits applicable to FSS earth stations operating with GSO networks

Working Party 4A agreed that any off-axis e.i.r.p. density masks that would be recommended to JTG 4-9-11 would be under the understanding that these levels be used as guidance by non-GSO systems designers in assessing the maximum interference level a non-GSO would receive from future GSO networks (4A/TEMP/152). Based on this understanding, WP 4A agreed that the off-axis e.i.r.p. density masks below are acceptable for communication carriers. Example changes to the Section VI of Article S22 to reflect results of studies are indicated in Annex 3 of JTG 4-9-11/US4R4P2.

a) 12.75 - 13.25 GHz and 13.75 - 14.5 GHz bands

Regarding the off-axis e.i.r.p. density limits for GSO FSS earth stations operating in the frequency bands 12.75 - 13.25 GHz and 13.75 - 14.50 GHz included in provision S22.26 and currently suspended, these levels have been reviewed by WP 4A which agreed that the level of e.i.r.p. emitted by an earth station shall not exceed the following values for any off-axis angle, ϕ , in any direction outside 3° of the GSO arc (4A/TEMP/152):

Off-axis angle	Maximum e.i.r.p.
$3^\circ \leq \phi \leq 7^\circ$	$42-25 \log \phi$ dB(W/40 kHz)
$7^\circ < \phi \leq 9.2^\circ$	21 dB(W/40 kHz)
$9.2^\circ < \phi \leq 48^\circ$	$45-25 \log \phi$ dB(W/40 kHz)
$48^\circ < \phi \leq 180^\circ$	3 dB(W/40 kHz)

For FM-TV emissions with energy dispersal, the limits above may be exceeded by up to 3 dB provided that the off-axis total e.i.r.p. of the transmitted FM-TV carrier does not exceed the following values:

Off-axis angle	Maximum e.i.r.p.
$3^\circ \leq \phi \leq 7^\circ$	$56-25 \log \phi$ dBW
$7^\circ < \phi \leq 9.2^\circ$	35 dBW
$9.2^\circ < \phi \leq 48^\circ$	$59-25 \log \phi$ dBW
$48^\circ < \phi \leq 180^\circ$	17 dBW



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CPM TEXT FOR CHAPTER 3, SECTION 3.1.3

3.1.3 Sharing between non-GSO FSS and GSO BSS systems in the bands 11.7 - 12.5 GHz (Region 1), 11.7 - 12.2 GHz and 12.5 - 12.75 GHz (Region 3), 12.2 - 12.7 GHz (Region 2), 17.3 - 18.1 GHz (Regions 1 and 3) and 17.8 - 18.1 GHz (Region 2)

3.1.3.1 Protection of GSO BSS systems

Resolution 538 (WRC-97) introduced provisional EPFD_{down} and APFD (EPFD_{up}) limits for non-GSO FSS systems in certain bands intended to protect GSO BSS systems operating co-frequency, and requested ITU-R to conduct the appropriate technical, operational and regulatory studies to review the regulatory conditions relating to the coexistence of non-GSO FSS and GSO BSS systems. Joint Task Group 4-9-11 has been assigned the responsibility for reporting the results of those studies to CPM-99.

The ITU-R developed a draft new Recommendation (DNR), "Protection of the broadcasting-satellite service in the 12 GHz band and associated feeder links in the 17 GHz band from interference caused by NGSO FSS system", referred to as BSS DNR in the rest of Section 3.1.3. This Recommendation addresses protection criteria, contains the BSS links to be protected (as modified in the JWP 10-11S May meeting), and descriptions of methodologies to be used in verifying protection of the BSS service. *Recommends* 2 of this DNR read as follows:

- 2 that the equivalent power flux-density (EPFD) and aggregate power flux-density (APFD) limits as defined in Article S22 of the Radio Regulations and applicable respectively to NGSO FSS systems to be operated in the 12 GHz bands shared with BSS and in the 17 GHz frequency bands shared with BSS feeder links be derived and specified in such a way:
 - 2.1 that they satisfy the criteria in *recommends* 1.1 and 1.2 above when applied to a set of representative GSO BSS and associated feeder-link system characteristics, as provided in Annex 1 to this Recommendation;
 - 2.2 that the apportionment of the aggregate interference allowance specified in *recommends* 1.1 and 1.2 to derive single entry limits be based on the number of NGSO FSS systems that are anticipated to share the same frequency bands;
 - 2.3 that these limits are specified by continuous curves of cumulative density function for a range of representative GSO receiving antenna sizes;

Recommends 2.1 requires that all the GSO BSS links provided in Annex 1 of the DNR be protected to the level specified in *recommends* 1.1 and 1.2 (see Section 3.1.3.1.2). The links in Annex 1 include all BSS links submitted by administrations in response to CR/92 and CR/116, which requested that administrations provide details of characteristics of BSS systems using the Plans as well as those being considered for future Plan modifications. The ITU-R agreed that if a proposed EPFD_{down} mask does not protect all BSS systems according to the protection criteria in *recommends* 1.1 and 1.2 of the PDNR, then the "non-adequately protected" BSS links would need to be examined further. Discussions with the affected administration would be held before definitive conclusions to determine whether additional measures (practical or analytical) would alleviate the excessive interference levels.

Several studies have shown that the provisional EPFD_{down} limits adopted by WRC-97 do not adequately protect the BSS service and therefore need to be modified. As shown above in *recommends* 2.3 it has been agreed that the limits be specified as continuous curves, rather than discrete points as adopted by WRC-97, for a range of GSO receiving antenna sizes. The agreed upon criteria to protect GSO BSS systems from non-GSO FSS interference can be met with many different shapes. From a GSO BSS perspective, the actual shape is not important as long as the criteria has been met. Studies have shown that the shape of the curve is very important to NGSO FSS systems, and certain shapes facilitate the ability of some NGSO FSS systems to meet the EPFD_{down} limits.

WRC-97 adopted EPFD_{down} limits for Region 2 for 45 cm, 100 cm, 120 cm and 180 cm diameter BSS earth station antennas. In order to more fully protect the GSO BSS service in Region 2 EPFD_{down} limits should also be specified for 60 cm, 90 cm and 240 cm antennas.

3.1.3.1.1 Characteristics of GSO BSS

In order to obtain the characteristics of the GSO BSS links that are to be protected, Special Rapporteur Group 2 of Joint Working Party 10-11S was formed to address a number of issues related to NGSO-FSS and GSO BSS sharing. The Special Rapporteur requested administrations to provide BSS link characteristics for their systems. Administrations submitted the data at JWP 10-11S meeting or in response to ITU-R CR/92 and CR/116. The complete set of submitted links are contained in Annex 1 of the BSS DNR. This database of links includes both reference parameter links, operational links and links representing future technologies. They represent links employing both digital modulation techniques and FM analogue modulation techniques. The range of earth station sizes is from [30 cm] to 240 cm.

In addition to the link characteristics, it is also necessary to establish the victim BSS earth station antenna characteristics. This is needed to properly determine the statistical distribution of EPFD_{down} levels for a given NGSO-FSS system. In developing the appropriate earth station pattern to be used, careful consideration was taken to use antenna patterns representative of BSS antennas currently in use. This both ensures the protection of the BSS service and limits the over-estimation of interference caused by non-GSO FSS systems. The ITU-R adopted a DNR, "Reference antenna radiation patterns for BSS earth stations used for individual reception in frequency bands covered by Appendix S30 for use in NGSO frequency sharing studies", referred to as BSS earth station DNR in the rest of Section 3.1.3. This DNR proposes a three-dimensional antenna pattern be used for earth stations with diameters from 45 cm to 60 cm. For larger earth stations, two-dimensional patterns are specified - one for D/L < 100 and another for D/L ≥ 100. These patterns should be used when generating EPFD_{down} interference characteristics from a given NGSO FSS system in a victim BSS antenna.

S9.16B, the request for coordination would be sent by the requesting administration to the identified administrations under S9.29. Alternatively, the provisions in S9.16A and S9.16B could instead be placed as S9.13A and S9.13B thereby causing the requesting administration to send the information to the Bureau under S9.30 and the Bureau to act under S9.34 to publish the information in the Weekly Circular.

ARTICLE S9

Sub-Section IIA - Requirement and request for coordination

ADD S9.16A

vi) which is a specific earth station within a geostationary-satellite network in the fixed-satellite service in certain frequency bands subject to S5.441 or S5.484A, in respect of a non-geostationary satellite system in the fixed-satellite service;

Reasons: GSO FSS earth stations with large antennas are not adequately protected by the EPFD levels contained in Table S22-3 and case-by-case coordination is required. Since coordination between a non-GSO FSS space station and large GSO FSS earth stations is a new type of coordination that does not currently exist in Article S9, it is necessary to add two new entry points in Article S9:

- One entry point to enable the non-GSO space station administration to request coordination with administrations having specific large earth station antennas.
- Another entry point to enable the reciprocal coordination to take place, i.e. the possibility for an administration planning to implement a specific large GSO earth station to request coordination with administrations having non-GSO FSS transmit space stations.

ADD S9.16B

vii) which is a non-geostationary-satellite system in the fixed-satellite service in certain frequency bands subject to S5.441 or S5.484A, in respect of a specific earth station within a geostationary satellite network in the fixed-satellite service;

Reasons: Same as the reason for S9.16A.

TABLE S22-3^{ZZ}

PART A

TABLE S22-3^{ZZ}

PART B

ADD^{ZZ}

For certain receive earth stations, this Table is not applicable and coordination is required under S9.16A and S9.16B.

Reasons: The EPFD_{down} levels contained in **Table S22-3** do not adequately protect earth stations in geostationary satellite networks in the fixed-satellite service with large antenna gains. Case-by-case coordination is required by the proposed modifications to footnotes **S5.441** and **S5.484A**.

Since there is no requirement to give the specific locations of earth stations today, there may need to be a resolution written to have typical earth stations, already in coordination or notified, that meet the above criteria to be brought in as specific earth stations. In this resolution, there will have to be some guidance on priorities. Additional guidance will need to be added to the *Instructions for Filling Out the Form of Notice ApS4/II and ApS4/III Relating to Space Radiocommunication Stations* distributed by CR/65.

MOD TO APPENDIX S4

ANNEX 2B (TO APPENDIX S4)

Table of characteristics to be submitted for space and radio astronomy services

(Only these two columns are reproduced. These changes need to be incorporated into the full table.)

C - Characteristics to be provided for each group of frequency assignments for a satellite antenna beam or an earth station antenna

MOD

Items in Appendix	Notification or coordination of a GSO network (including Appendix S30B)
C.9.a	C
C.9.b	
C.9.c	
C.10.a	X
C.10.b	<u>XZZ</u>
C.10.c.1	X
C.10.c.2	X
C.10.c.3	X
C.10.c.4	X
C.10.c.5	X
C.10.c.6	
C.11.a	X
C.11.b	
C.11.c	
C.11.d	
C.12	
C.13	
C.14	

3.1.3.1.2 Protection criteria

The BSS DNR outlines the protection criteria for BSS from non-GSO FSS interference. Specifically, the Recommendation reads as follows:

recommends

- 1 that for a GSO/BSS network in the 12 GHz band and its associated feeder links in the 17 GHz band, the aggregate inter-network interference caused by the earth and space station emissions of all NGSO-FSS satellite networks operating in the same frequency band, should:
 - 1.1 be responsible for at most 10% of the time allowance(s) for unavailability of the given C/N value(s) as specified in the performance objectives of the desired network, where N is the total noise level of the wanted carrier including all other non-time-varying sources of interference;
 - 1.2 not lead to a loss of MPEG video picture continuity in the desired digital GSO BSS and associated feeder link network under clear sky conditions;

3.1.3.1.3 Methodologies used to assess the adequacy of the limits to protect GSO BSS

As discussed in the previous section there are two criteria for the protection of GSO BSS from non-GSO FSS interference. The ITU-R developed a methodology to determine whether the first criterion, a 10% increase of the BSS link unavailability, was met. The ITU-R evaluated two software implementations, referred to as DMS and Monte Carlo, of the JWP 10-11S methodology. Both software programs led to results which were quite similar and are considered correct. These methodologies are described in detail in Annexes 2 and 3 of BSS DNR. *Recommends* 3 of BSS DNR establishes that one of these software programs should be used in assessing the impact on the GSO BSS from non-GSO FSS systems.

recommends

- 3 that the methodology given in Annexes 2 and 3, in connection with an appropriate assumed number of NGSO-FSS systems, be applied for assessing the impact on the GSO BSS in the 12 GHz band and the associated feeder links in the 17 GHz band of EPFD and APFD limits applicable to the NGSO FSS.

The ITU-R also developed an approach for assessing whether the second criterion, loss of MPEG video picture continuity, was met. The approach can be applied using the BSS system characteristics contained in the BSS link database and consists of a straightforward link calculation using the highest EPFD_{down} level generated by the non-GSO FSS system. This approach is described in detail in Annex 4 of the BSS DNR. *Recommends* 4 of the BSS DNR establishes that this approach should be used in assessing the impact on the GSO BSS from non-GSO FSS systems.

recommends

- 4 that the approach described in Annex 4 be used to assess if the provisions of *recommends* 1.2 are satisfied.

A method for deriving a single entry EPFD_{down} mask from an aggregate EPFD_{down} mask needs to be developed. Several approaches have been reviewed.

3.1.3.1.4 Results of studies relating to the review/revision of the provisional power limits appearing in Section II of Article S22

The results of studies have shown that the provisional WRC-97 EPFD_{down} limits need to be modified. In general these limits do not provide adequate protection to GSO BSS systems. The following aggregate EPFD_{down} masks, for Region 2, provide protection in accordance with BSS DNR to all of the Region 2 links submitted by administrations. To develop single entry masks an N_{eff} of 3.5 NGSO FSS systems should be used.

Proposed aggregate EPFD_{down} mask, 45 cm antenna, Region 2

Aggregate mask All NGSO systems	
EPFD _{down} dBW/m ² /4 kHz	P (X<EPFD), %
-179	98.43
Slope = -12.5 dB/decade to -179	
-170	99.70
-170	100

Proposed aggregate EPFD_{down} mask, 60 cm antenna, Region 2

Aggregate mask All NGSO systems	
EPFD _{down} dBW/m ² /4 kHz	P (X<EPFD), %
-180.5	99.48
Slope = -12.5 dB/decade to -171.5	
-171.5	99.90
-171.5	100

Proposed aggregate EPFD_{down} mask, 90 cm antenna, Region 2

Aggregate mask All NGSO systems	
EPFD _{down} dBW/m ² /4 kHz	P (X<EPFD), %
-185.5	99.00
Slope = -12.5 dB/decade to -173	
-173	99.90
-173	100

Proposed aggregate EPFD_{down} mask, 120 cm antenna, Region 2

Aggregate mask All NGSO systems	
EPFD _{down} dBW/m ² /4 kHz	P (X<EPFD), %
-189.8	95.596
Slope = -12.5 dB/decade to -175.2	
-175.2	99.70
-175.2	100

Proposed aggregate EPFD_{down} mask, 180 cm antenna, Region 2

Aggregate mask All NGSO systems	
EPFD _{down} dBW/m ² /4 kHz	P (X<EPFD), %
-192.8	96.057
Slope = -12.5 dB/decade to -178.8	
-178.8	99.70
-178.8	100

Proposed aggregate EPFD_{down} mask, 240 cm antenna, Region 2

Aggregate mask All NGSO systems	
EPFD _{down} dBW/m ² /4 kHz	P (X<EPFD), %
-195	99.37
Slope = -12.5 dB/decade to -184	
-184	99.9
-184	100

3.1.3.2 Protection of non-GSO FSS systems

See Section 3.1.2.2.

3.1.3.3 Feasibility of the limits and constraints on the development of the systems and services involved

It is imperative to the continued success of the BSS that the EPFD_{down} limits adopted meet the ITU-R agreed upon criteria to protect the GSO BSS from non-GSO FSS systems. The BSS is provided to millions of consumers and any degradation in the service places the BSS at a significant disadvantage to its competitors. Failure to meet the 10% unavailability criterion, specified in *recommends* 1.1, increases the sensitivity of the BSS system to rain beyond acceptable levels. The consumer would see additional or longer outages when rain occurs; i.e. a moderate rain shower that had not been causing outages would lead to outages due to the addition of the non-GSO interference. Equally detrimental to the BSS would be a failure to meet the loss of MPEG video picture continuity specified in *recommends* 1.2. This would cause break-up of service on a recurring basis with no obvious cause to the consumer. Therefore it is necessary that the adopted EPFD_{down} limits meet the specified criteria to protect the GSO BSS.

3.1.3.4 Regulatory and procedural considerations

See relevant paragraphs in Section 3.1.2.4.



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MODEL RESOLUTION XXX

**(FOR INCLUSION IN THE REGULATORY ANNEX TO
CHAPTER 3 OF THE CPM-99 REPORT)**

The following model resolution is intended for inclusion in the regulatory materials annex to Chapter 3 of the CPM-99 Report. It is associated with text from section 3.1.1.3 (see Document 4-9-11/383).

MODEL RESOLUTION XXX (WRC-2000)

**PROTECTION OF GSO FSS AND GSO BSS NETWORKS FROM THE AGGREGATE
EQUIVALENT POWER FLUX-DENSITY PRODUCED BY MULTIPLE NON-GSO FSS
SYSTEMS IN FREQUENCY BANDS WHERE EPFD LIMITS
HAVE BEEN ADOPTED**

The World Radiocommunication Conference (WRC-2000, Istanbul),

considering

- a) that WRC-97, in Resolution 130 (WRC-97), decided to include in Article S22 provisional power limits to be met by non-GSO FSS systems in order to protect GSO FSS and GSO BSS networks in some frequency bands in the 10.7 - 30 GHz range;
- b) that WRC-2000 has revised these limits to ensure that they provide the requisite protection without causing undue constraints to any of the systems and services sharing these frequency bands;
- c) that these single-entry limits specified in Article S22 apply to each non-GSO FSS system in these bands;
- d) that the single-entry limits in Article S22 have been derived from aggregate equivalent power flux-density (epfd) masks that are intended to protect GSO networks;
- e) that there is a need to ensure that the aggregate epfd produced by all co-frequency non-GSO FSS systems in the frequency bands referred to in *considering* a) above into GSO FSS and/or GSO BSS networks does not exceed the maximum interference levels that are necessary to protect these GSO networks;

f) that WRC-97 decided, and WRC-2000 confirmed, that non-GSO FSS systems in these bands are to coordinate the use of these frequencies between themselves under the provisions of No. S9.12 of the Radio Regulations;

g) that because the orbital characteristics of such systems are likely to be inhomogeneous, the aggregate epfd levels from multiple non-GSO FSS systems are not directly related to the number of actual systems sharing a frequency band,

resolves

1 that the aggregate epfd produced by all non-GSO FSS systems operating co-frequency in the frequency bands referred to in *considering a)* above into GSO FSS and GSO BSS networks shall not exceed the aggregate power levels shown in Annex 1;

2 that, in addition to being subject to the application of the procedures of Article S9, before a non-GSO FSS system may be brought into use in a frequency band referred to in *considering a)* above, the Radiocommunication Bureau shall have verified that the simultaneous operation of the new non-GSO FSS system and all other co-frequency operating non-GSO FSS systems does not exceed the aggregate power levels shown in Annex 1¹,

requests the Director of the Radiocommunication Bureau

to apply the procedures in Annex 2 when verifying that the aggregate power limits shown in Annex 1 are not exceeded,

requests the ITU-R

1 to develop, as a matter of urgency, and complete, in time for consideration by WRC-2003, a methodology for verifying that the aggregate epfd produced by all non-GSO FSS systems operating co-frequency in the frequency bands referred to in *considering a)* above into GSO FSS and GSO BSS networks does not exceed the aggregate power levels shown in Annex 1;

2 to continue its studies on the accurate modelling of interference from non-GSO FSS systems GSO FSS and GSO BSS networks in the frequency bands referred to in *considering a)* above in order to assist the administrations planning or operating non-GSO FSS systems in their efforts to limit the aggregate epfd levels produced by their systems into GSO networks.

¹ The regulatory procedures implementing this provision should specify that if a non-GSO FSS system is ready to be brought into use and the tools required by BR to verify compliance with the aggregate epfd limits have not been approved for use, the bringing into use period for such a system shall be extended to a date not earlier than six months after the date on which the software tool has been approved for use by BR. In addition, the procedures should specify that if an administration submits parameters to BR for verification of compliance with the aggregate epfd limits at least six months before its bringing into use deadline under Article S11 of the Radio Regulations and is otherwise in compliance with applicable regulations, its bringing into use deadline shall be six months after BR publishes its findings on verification, or the end of the bringing into use period currently specified under Article S11, whichever is later.

ANNEX 1

Aggregate epfd limits

[TBD]

ANNEX 2

Procedures for verifying compliance with Annex 1

[TBD]

EDITORIAL NOTE - Specific regulatory proposals for Annex 2 to model Resolution XXX are currently being developed for submission to the SCRPM meeting to be held in July 1999.
